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(54) Swivelling apparatus having means for counter-balancing equipment connected thereto during pitching movements

(57) In swivelling apparatus of the kind having a stator and a rotor which can be swivelled around the stator in the pitching direction, counter-balancing means comprising a force-storing device is arranged between the stator and the rotor which exerts a restoring moment on the rotor corresponding to the moment of the equipment during a pitching movement.

The counter-balancing means (10) comprises a plurality of independent force-storing devices (11) which, via a locking element 20, can be brought selectively into effective connection between the stator (2) and the rotor (4).

Unlike the swivelling apparatus known until now in which individual counter-balancing means were provided depending upon the weight of the equipment to be used, the invention provides counter-balancing means in the form of a plurality of force-storing devices which are brought into use individually, or in combination, as required.

FIG.3

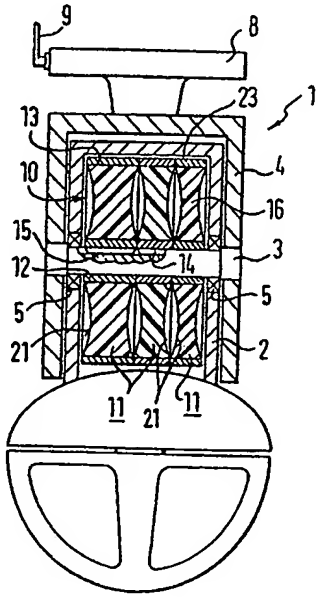
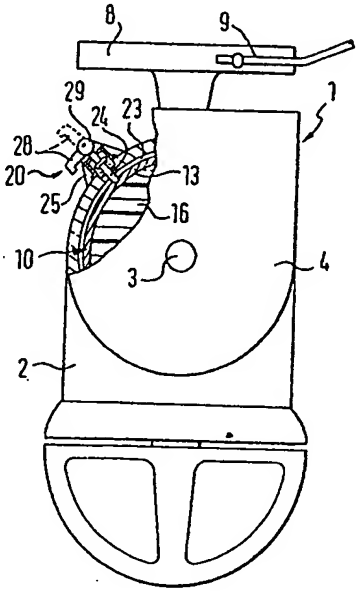


FIG.4



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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

FIG. 1

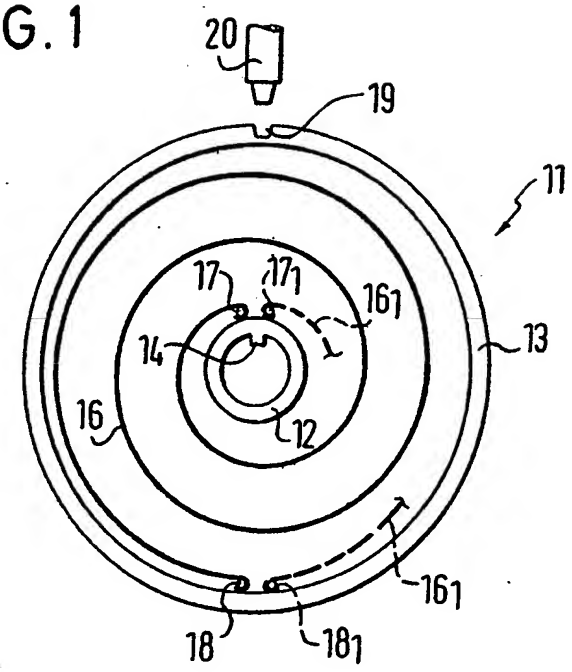


FIG. 2

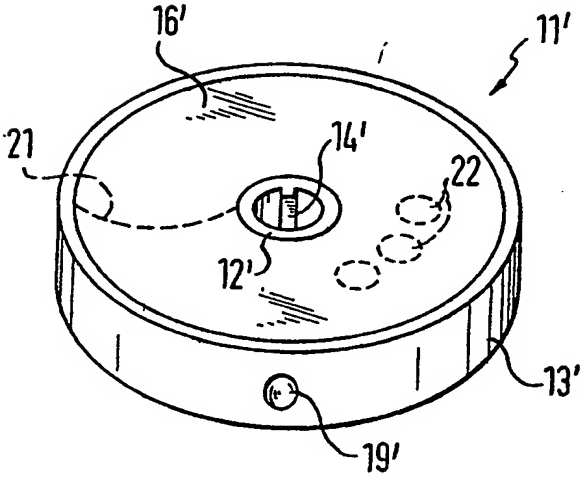


FIG. 3

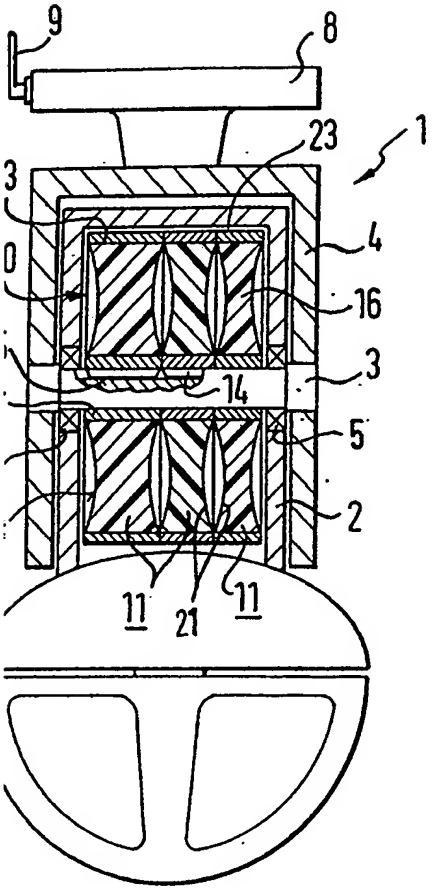


FIG. 4

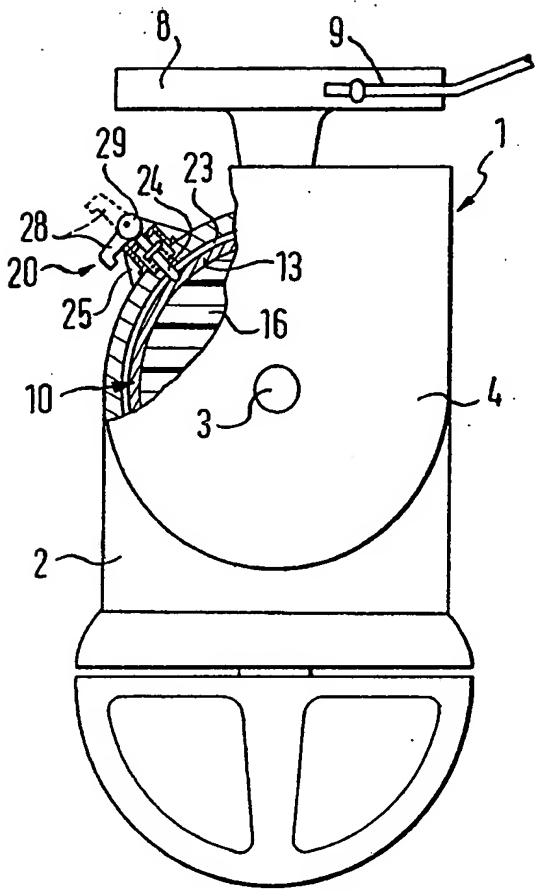


FIG. 5

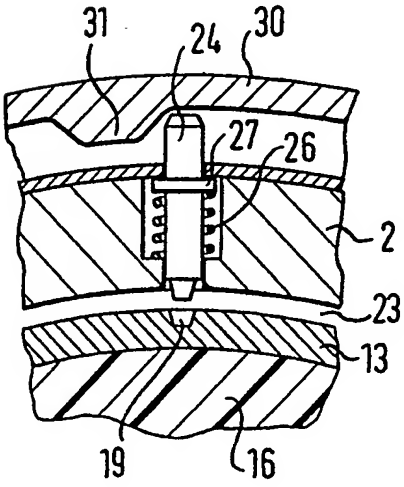
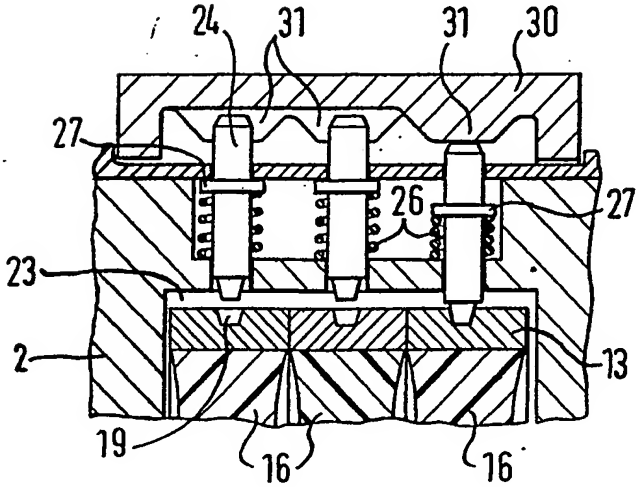


FIG. 6



SPECIFICATION

Swivelling apparatus having means for counter-balancing equipment connected thereto during pitching movements

The invention relates to swivelling apparatus having counter-balancing means for counter-balancing equipment connected to said apparatus during pitching movements, and particularly a film or television camera fixed to a pivotable stand head, wherein the swivelling apparatus has a stator and a rotor which can be swivelled around the stator in the pitching direction, and the counter-balancing means have a force-storing device arranged between the stator and the rotor which exerts a restoring moment on the rotor corresponding to the moment of the equipment during a pitching movement.

In swivelling apparatus of this kind, such as the heads on stands for film or television cameras, the counter-balancing means are used with the aim of ensuring that the equipment or the camera is approximately in a state of equilibrium during swivelling movements, in every pitching position, i.e. that a restoring moment is produced by the counter-balancing means corresponding approximately to the moment of the camera in the relevant pitching position. By this means, the camera remains in the pitched position it has attained without any holding force having to be applied for this purpose. In addition, the swivelling force is reduced thereby and is made more even over the whole swivelling range of the swivelling apparatus, so that overall it is possible to carry out gentler pitching movements.

The simplest form of counter-balancing means consists in arranging helical or spiral springs with a restoring force which is adapted to the equipment, e.g. to the camera, on the swivelling apparatus around the pitching axis, to counteract the moment occasioned by the equipment during pitching movements.

Instead of a spring, a torsion bar built into the head of the stand is often used for counter-balancing heavy stand heads for film cameras, for example.

The known counter-balancing means with springs or torsion bars are normally designed for equipment of one specific weight. In order to enable variously heavy cameras to be used on one and the same stand head for film or television cameras, the counter-balancing means can be changed. If another camera is to be used, with a different weight from the camera being used until then, the counter-balancing means previously used is dismounted from the stand head and exchanged for another counter-balancing means adapted to the weight of the new camera.

This operation is often laborious and time-consuming, so that, at least for counter-balancing means incorporating springs, it has been proposed that said means should be constructed as a self-contained cassette which is connected via a simple clamping device to the stand head for a film or television camera; see DE-PS 27 17 772. In this case, a plurality of balancing cassettes adapted to various camera weights have been made available; these are connected to the pivotable stand head as required, according to the weight of the camera.

An object of the invention is to provide such swivelling apparatus which is constructively simple and which can be adapted quickly to counter-balance different camera weights.

According to the invention such swivelling apparatus is characterised in that the balancing means comprise a plurality of independent force-storing devices which can be brought selectively into effective connection between the stator and the rotor of the swivelling apparatus.

Unlike the swivelling apparatus known until now, the invention takes another direction from that following until now, namely by building into the swivelling apparatus counter-balancing means in the form of a plurality of force-storing devices which can be brought into use individually, or in combination, according to the weight of the equipment being used at the time. In this way, with suitable settings for the restoring force of the force-storing devices involved, in conjunction with the possibilities for locking the force-storing devices to the stator and the rotor, it is possible to adjust the restoring moment provided by the counter-balancing means over a wide range of weights. For example, if three independent force-storing devices are provided in the counter-balancing means, then sevel levels of restoring moment, corresponding to seven different equipment weights, can be set by selectively connecting in these three individual force-storing devices.

According to a preferred embodiment of the invention, the individual force-storing devices are spring elements which are disposed adjacent to each other on the pitching shaft which is mounted in the stator, and are each connected permanently to the said pitching shaft by one of their ends, and can be locked selectively onto the part which does not rotate with the shaft, i.e. according to the installation of the pitching shaft, onto the stator or the rotor, by their other end. Preferably, the force-storing devices each have an inner ring which can be pushed onto the pitching shaft and locked thereto, and a concentric, lockable outer ring, together with a spring element arranged between the two rings.

A simple helical spring can be used as the spring element, for example, clamped in between the two rings; however, it is very much more advantageous and expedient to connect the two rings to each other with a rubber-elastic material; normal commercially available latex, rubber or some other synthetic material can be used, such as is used, for instance, for so-called vibration mountings. The Shore hardness of the gum-elastic material which is given the general designation "rubber" in the following, and the dimensions of the individual force-storing devices are adapted to the weight of the camera.

The force-storing devices are preferably in the

shape of a wheel, and the rubber material between the inner and the outer ring has either straight outer walls or, according to a preferred embodiment of the invention, tapering external walls in the central region between the rings. Unlike one with straight external walls, a rubber element with tapering external walls enables a greater angle of rotation to be achieved by the force-storing device, so that the swivelling range of the swivelling apparatus is extended. Although it would also be possible to provide transverse bores in a rubber element with straight external walls, in order thus again to increase the angle of rotation of the force-storing device, this solution has been found less satisfactory.

For connecting the individual force-storing devices to the stator and the rotor, each is provided with an eccentric, preferably disposed on the stator, which actuates a locking bolt. By actuating one locking bolt, or a plurality of locking bolts in a desired combination, the corresponding force-storing devices are connected up between the stator and the rotor, and the restoring moment level is set. It is equally possible to provide a common control device connected to a central control handle for all the locking bolts, by means of which all the locking bolts, e.g. each controlled by an eccentric or by other means, can be brought in the desired combination into engagement with the force-storing devices.

In order that the invention may be readily appreciated two embodiment examples of swivelling apparatus in accordance therewith will now be described with reference to the accompanying drawings, in which:—

Figure 1 is a front view of a first embodiment of force-storing device for the counter-balancing means of the swivelling apparatus,

Figure 2 is a general view of a second embodiment of force-storing device,

Figure 3 is a longitudinal section through the first embodiment of swivelling apparatus, in this case a stand head for a film or television camera, according to the invention, having counter-balancing means in the form of a plurality of independently connectable force-storing devices,

Figure 4 is a partially-sectioned side view of the stand head shown in Figure 3.

Figure 5 is an enlarged, partial cross-section view of the second embodiment of swivelling apparatus, corresponding to the view shown in Figure 4, and wherein the individual force-storing devices of the balancing means can be connected by a common operating handle, and

Figure is a cross-section through the central operating handle and part of the swivelling apparatus according to the invention, illustrating the locking of the individual force-storing devices of the balancing means:

Referring to Figure 3 the swivelling apparatus, in the form of a stand head 1 for a film or television camera, has a stator 2 which supports a rotor or pitching shaft for the stand, in the hemispherical holding socket thereof. A rotor 4 with a U-shaped cross-section surrounding the stator is pivoted around the rotor shaft 3, which latter is mounted in the stator 2 via appropriate bearings 5. The rotor 4 bears on its upper face a holding plate 8 on which the film or television camera, which is not shown in the Figures, can be fixed. By means of a handle 9, which is shown only schematically and is fixed to the holding plate 8, the rotor with the camera fixed thereon can be swivelled around the stator.

Between the stator 2 and the rotor 4 counter-balancing means 10 are arranged which are used to supply a restoring moment when the rotor with the camera fixed on it is swivelled, the said restoring moment being equal to the pivoting moment exerted by the weight of the camera, but opposite thereto. In this instance, the counter-balancing means include three force-storing devices 11, each of wheel-shaped construction, pushed inside the stator onto the rotor shaft 3 and clamped thereto, and each of which can be locked onto the stator 2.

The design of the individual force-storing devices 11 may be according to either of the two different embodiments shown in Figures 1 and 2.

The force-storing device 11 shown in Figure 1 has an inner ring 12 and an outer ring 13, which are both made of aluminium. The inner ring 12 is pushed onto the rotor shaft 3 and, to lock it thereto, it has a nose 14 which engages in a correspondingly shaped groove 15 in the rotor shaft 3 and locks the inner ring rotationally fixed relative thereto; see Figure 3 as well, in this connection. Between the inner ring 12 and the outer ring 13 there is a spring element 16, which in this case is a spiral spring, clamped between two fixing points 17 (on the inner ring) and 18 (on the outer ring). In Figure 1 the spiral spring 16 is wound in a counter-clockwise direction. In addition to this single spiral spring, it is also possible to provide a second spiral spring 16_1, which is wound in the other direction, i.e. in a clockwise direction, and is clamped in between two fixing points 17_1 and 18_1 respectively.

If the inner ring 12 of the force-storing device 11 is held fixed and the outer ring 13 is rotated relative to the inner ring, then a restoring moment is exerted on the outer ring 13 by the spring 16 or the two springs 16 and 16_1, seeking to rotate the outer ring 13 back again into its rest position, i.e. into the position where the spring or spring arrangement is relaxed.

The outer ring 13 has on its outer surface a recess 19 by means of which the outer ring 13 can be connected to the stator 2 by means of a locking element 20 which is described below. Therefore, if a force-storing device 11 as shown in Figure 1 is pushed on the rotor shaft 3 of the swivelling apparatus 1, as shown in Figure 3, and the outer ring 13 is locked onto the stator 2 by the locking element 20, when the rotor 4 with the camera fixed on it is pivoted, with appropriate adaptation of the spring constants of the spiral springs 16, a restoring moment is produced which corresponds to the pivoting moment produced by the weight of the camera, but is opposite to it.

Figure 2 shows another embodiment of a force-storing device 11'. This force-storing device again has an inner ring 12' which can be pushed on the rotor shaft, with a nose 14' which engages in the groove 15 on the rotor shaft 3, and an outer ring 13' with a recess 19' for locking purposes. As the spring element between the inner ring 12' and the outer ring 13' a rubber ring 16' connected to both rings is provided. Connection is effected, for example, during vulcanisation by a chemical or physical process. Such techniques for joining metal and rubber or other elastic materials are known in the industry. The Shore hardness for the material of the spring element which is designated here in a general way as "the rubber ring 16'", irrespective of the type of material used, is chosen so that when the outer ring 13' is locked the force-storing device 11' supplies a restoring moment which corresponds to the pivoting moment of a camera with a specific weight, but opposite thereto.

It has been found that it is expedient if, irrespective of the Shore hardness value chosen, the cross-section of the rubber ring 16' tapers in the central zone between the inner ring 12' and the outer ring 13'. With this design for the rubber ring the relative angle of rotation which can be obtained between the inner ring and the outer ring can be increased compared with a rubber ring with a uniform cross-section. This cross-section tapering of the rubber ring 16' is designated 21 in Figure 2 and also in Figure 3. Instead of cross-section tapering 21, or additionally thereto, the rubber element 16' may also have transverse bores or reduction bores 22 which traverse the rubber body either right the way through or part of the way through.

To produce the counter-balancing means 10 a plurality of force-storing devices 11 are pushed onto the rotor shaft 3 and clamped thereon, so that the noses 14 engage in the groove 15 on the rotor shaft. As can be seen in Figure 3, between the outer rings 13 and the stator 2 a small annular gap 23 remains so that the outer rings do not rest on the stator 2.

The outer rings 13 of the individual force-storing devices 11 can be locked onto the stator 2 independently of each other by means of the said locking elements. Such a locking element 20 is shown schematically in Figure 4. The locking element 20 has a locking pin 24 which passes radially through a mounting 25 in it and in the stator 2, and is braced in the mounting 25 by a compression spring 26. The locking pin 24 is held in its rest position with the compression spring 26 relaxed, so that it does not come into contact with the outer ring 13 of a force-storing device. The locking pin 24 has a collar 27 which is pressed in the rest position by means of the compression spring 26 against the inner face of the mounting 25, and is held in this position. A hinged lever 28 is connected to the mounting 25, and bears an eccentric 29 which rests via its eccentric cam on the outer end of the locking pin 24. By rotating the hinged lever 28 from the position shown in dashes in Figure 4 into the position shown in full lines, the locking pin is pushed radially into the cylindrical stator 2 and rests on the outer circumference of the outer ring 13 of a force-storing device 11, and when the stand head is held in the normal position and the locking pin 24 and the recess 19 on the outer ring line up with each other, it engages in this recess 19, whereby the outer ring 13 of the force-storing device 11 is locked relative to the stator. The selected force-storing device is thereby connected up between the stator and the rotor. Depending on the spring constants of the force-storing device concerned, when the rotor 4 carries out pivoting movements around the axis of the shaft 3, a restoring moment is produced which counteracts the pivoting moment produced by the camera set upon it.

When, as shown in Figure 3, the counter-balancing means 10 have three independent force-storing devices, each having different spring constants, which are constructed in this case as three variously thick spring rings as shown in Figure 2, then each of these force-storing devices can be locked onto the rotor by its own locking element 20. The individual force-storing devices here each produce a different amount of restoring moment when they are locked in. In the simplest case this can be achieved by using spring elements 16 which all have the same spring constants, i.e. in the case of rubber rings, the same Shore hardness. The thickness of the individual force-storing devices then differs according to this chosen Shore hardness, as indicated in Figure 3. Naturally, it would also be possible to make the thickness of the individual force-storing devices the same, despite different spring constants, by selecting, for example, a different Shore hardness for the separate rubber rings, as shown in Figure 6.

Instead of locking each of the individual force-storing devices to the stator by its own locking element 20, it is also possible to use a common, central operating handle 30 for all the locking pins of the individual force-storing devices as shown in Figures 5 and 6. In this case, the central operating handle surrounds the cylindrical stator 4 and has a plurality of control cams 31 formed as raised projections on its inner circumference. These control cams 31 are used to press one locking pin 24 at a time into a recess 19 in a force-storing device as the central operating handle 30 is rotated correspondingly. By arranging the control cams 31 appropriately on the inner surface of the central operating handle one of the locking pins or a plurality of the locking pins in combination can be engaged with the individual force-storing devices according to the setting of the central operating handle.

Naturally, modifications of the embodiment example are possible within the scope of the invention. For example, it would be possible to mount the pitching shaft permanently in the stator so that the rotor would be pivoted around this stator shaft. Correspondingly, the force-storing devices clamped on the stator shaft would then

have to be locked selectively to the rotor. The design of the common operating member and that of the locking mechanism is given only by way of example, and in this case as well design modifications which produce the same effect may be incorporated.

The invention provides apparatus which is of simple construction, and is very compact and easy to use, for counter-balancing equipment connected to swivelling apparatus during pivoting movements. By appropriate selection and combination of the restoring moment supplied by the individual force-storing devices, the pivoting moment of equipment with a wide range of different weights can be equalised with the balancing means of said swivelling apparatus.

CLAIMS

1. Swivelling apparatus having means for counter-balancing equipment connected to said apparatus during pitching movements, the swivelling apparatus having a stator and a rotor which can be swivelled around the stator in the pitching direction, and the counter-balancing means having a force-storing device arranged between the stator and the rotor which exerts a restoring moment on the rotor corresponding to the moment of the equipment during a pitching movement, characterised in that the counter-balancing means comprise a plurality of independent force-storing devices which can be brought selectively into effective connection between the stator and the rotor.

2. Apparatus according to Claim 1, characterised in that the rotor includes a rotor or pitching shaft which is supported by the stator, in that the individual force-storing devices have spring elements which are disposed adjacent to each other on the pitching shaft and are each permanently connected to the pitching shaft via one of their ends, and in that each spring element can be locked at its other end onto the stator.

3. Apparatus according to Claim 2, characterised in that each force-storing device has an inner ring which can be pushed onto the pitching shaft and locked thereon, a concentric outer ring for selective locking onto the stator, and a spring element disposed between the two rings.

4. Apparatus according to Claim 3, characterised in that the spring element between the inner and outer ring is a spiral spring, or a spiral spring arrangement composed of two counter-wound spiral springs.

5. Apparatus according to Claim 2 or 3, characterised in that the spring element between the inner and outer ring of each force-storing device is a rubber annulus which is securely connected to said rings, preferably by vulcanisation or a similar rubber-metal connection.

6. Apparatus according to Claim 5, characterised in that the rubber element has outer walls which taper in cross-section in the central region between the inner and outer rings.

7. Apparatus according to any one of the preceding Claims, characterised in that, to lock each of the individual force-storing devices, there is a locking device with an eccentric and with a locking bolt which engages in the force-storing device and holds it securely.

8. Apparatus according to any one of the preceding Claims, characterised in that, to lock the force-storing devices either individually or in combination, a central control device connected to an operating handle is provided.

9. Apparatus according to Claim 8, characterised in that the operating handle has cams which are used to lock the force-storing devices individually or in combination, according to the setting of the operating handle.

10. Swivelling apparatus having means for counter-balancing equipment connected thereto constructed, arranged and adapted for use substantially as hereinbefore described with reference to, and as shown in, Figures 3 and 4, or Figures 5 and 6 of the accompanying drawings.

11. Swivelling apparatus according to any one of the preceding Claims, in the form of stand head for a film or television camera.

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